This species differs from *T. spinosa* in having the deep strongly marked fold formed by a depression of the larger, and the elevation of the smaller valve. The number of the plaits is fewer, and it does not appear to attain a larger size than the specimen figured. This species is common in the Inferior Oolite of Appleby, Brigg, Lincolnshire, but it is difficult to obtain perfect specimens. I have dedicated this species to the Rev. J. E. Cross, M.A., F.G.S., who gave me the specimen figured.

I have presented the specimens figured to illustrate this paper to the British Museum.

EXPLANATION OF FIGURES OF LOWER GREENSAND BRACHIOPODA FROM UPWARE.

Figs. 1 and 2.—Front and side view of *Terebratula depressa*, var. *uniplicata*.

Figs. 3 and 4.—Front and side view of ——— var. *Cantabrigiensis*.

5.—Pallial border of same, showing the central elevation on the ventral valve.

Figs. 6 and 7.—Front and side view of *Terebratula Seeleyi*, sp. nov.

8.—Small example of same.

9.—Three views of *Rhynchonella Crossii*, sp. nov.

All the specimens are figured of the natural size.

VI.—ON THE DISPERSION OF CRIFFELL GRANITE AND CALDBECK PORPHYRY OVER THE PLAIN OF CUMBERLAND.¹

By D. MACKINTOSH, F.G.S.

THE following is a very brief statement of the results of nearly two months' observations on the granitic and porphyritic drift of the north and north-west of Cumberland.

Derivation and Mode of Dispersion of the Granitic Drift.—From a little to the east of Workington, the south-eastern boundary of this drift crosses the river Derwent, and runs along between Great Broughton and Wyndham Row, north of Tallantire, by Parsonby, and Torpenhow, in the direction of Ireby; it then winds round the west and north slopes of Brocklebank ridge in a line running south of the Red Dial and Nether Welton. I have found the granite as far east as Wetherall, and believe it extends much farther, while on the north it approaches, if it does not cross, the Scottish Border. The boulders, most of which have been dug out of the fields,² occur principally in a sea-coast area reaching as far south as Workington, as far north as Allonby, and nearly as far east as Mealsgate; though, in thinly-scattered groups, and isolated blocks of smaller size, they may be seen farther to the north and east.³ They rapidly increase in size and numbers towards the sea-coast, or in the direction of Criffell (on the opposite side of the Solway Firth), and gradually thin out inland until they can no longer be detected. There are comparatively few in the valley of the Ellen, even where other erratics are present. On the ridge to the north-west of this valley, and the part of the

¹ For Kirstone and Kirston, read Kirkstone, in my last article (GEOL. MAG. for Oct.).

² The so-called surface-blocks are those which have escaped being buried, or which have been disinterred by farmers. The boulders of granite and other rocks are found principally in the lower Boulder-clay, but they are not absent from the upper.

³ Nearly all the boulders are more or less rounded.

ridge to the south-east which is situated near to the sea-coast, the boulders are the most numerous. They generally occupy positions in which they may have been left by grounding ice-floes. The granite is much the same throughout the whole area over which it has been dispersed. Where the large boulders are most numerous, at least five out of six are of a very coarse-grained light-coloured or grey granite, with crystals up to three-fourths of an inch in breadth and two inches in length. It often presents a more or less reddish tinge, when it looks somewhat like Shapfell granite, from which, however, it is structurally distinct. It is undoubtedly the same as the granite found *in situ* along the southern base of Criffell, and there it occurs in cliffs, as well as in block-strewn slopes, from which the boulders may readily have been launched. Next to the large-crystalled granite, a grey variety resembling the granite now quarried near Dalbeattie, on the north-west side of Criffell, is the most abundant. I have found it as far east as Nether Welton. Connected with this variety, and often graduating into it, there is a dark, streaked, or semi-gneissose granite. The above three varieties are characterized by dark blotches or patches, up to two or three feet in diameter, which in some instances look like fragments of whinstone caught up in the once-molten mass, in others like the effect of a process akin to segregation. These blotches are characteristic of the Dalbeattie and Criffell granite *in situ*, and are of themselves sufficient to indicate the derivation of the erratic blocks. The largest blocks of granite I have seen, which have evidently been transported from the Scottish side of the Solway Firth, are on the beach near Flimby. There are four near to one another, and each is about $8\frac{1}{2} \times 7 \times 3$ feet.

In addition to the above varieties, there is a hard, reddish, coarse, syenitic granite, very abundant on the sea-coast among the smaller stones, and extending to the innermost boundaries of the granitic-drift area. I have not yet been able to trace its derivation. Mr. Mackenzie, of the Creetown Granite Works, near Wigtown, informs me that he has found it, in the shape of boulders, in his neighbourhood, along the sea-coast, and up the bed of the Cree, growing coarser and not so red near Cairnsmore. He has also found a small boulder of red, large-crystalled granite, in drift, at the Fell Granite Works. The Fell granite *in situ* is fine-grained and nearly white, with about one-eighth part of black mica. In the granite of Bagbie-bar quarry, about a mile farther south, and near the sea, about one-third part is black mica. Both these granites, I believe, are represented in the Cumberland drift, especially among the smaller stones and boulders.¹

The principal facts above stated can, I think, be explained, in no other way than by supposing that the granitic boulders of Cumberland were derived from the opposite side of the Solway Firth. From

¹ Accompanying the granitic drift, especially on the sea-coast, there are numerous pebbles, and occasional boulders of dark, hard, fine-grained whinstone, which would appear to have come from the Scottish side of the Solway Firth, where, in many places, it is the prevailing rock.

Criffell, they must have radiated S., S.E., and E.¹ I have not yet ascertained if they were distributed in other directions. The greatest height at which I have found them is between 350 and 400 feet above the sea, at Parsonby and Nether Welton.²

Supposed Dispersion of Granite from Skiddaw.—The very limited exposures of granite in the Skiddaw area, and these chiefly at or near the bottoms of valleys or gills, would lead one to expect to find comparatively few indications of an exodus of granite from this area. The absence of granite from the district around Cockermouth (as I have had many opportunities of ascertaining), from the districts intervening between Cockermouth and Bassenthwaite, and between Bassenthwaite and the extreme south-east boundary of the granitic-drift area, shows that there has been no exodus of Syning Gill granite by way of Keswick and Bassenthwaite into north-west Cumberland; and I have not seen a bit of Syning Gill Granite in any part of the drift-area under consideration. The exodus of Skiddaw granite by way of Mosedale would likewise appear to have been very limited. I have not seen much granite to the north of Heskett New Market but what might have come from the Scottish coast. There is little or no granite strictly so called (so far as I could ascertain) in Caldbeck valley.

Dispersion of Porphyry, etc., from the Caldbeck and Carrock Fells.—From observations made since my last article was written, I have traced much of the North Cumberland drift to its source in these mountains. Felspathic trap, porphyry, and syenite have found their way S.E. and E.S.E. farther than the R. Eamont and Penrith; E. in the direction of Plumpton; N.E. and N. as far *at least* as the R. Eden; N.W. and W. as far as the sea-coast. Erratics from these hills have been carried across the Caldbeck valley and lodged on Brocklebank ridge up to a height of at least 950 feet above the sea. N., N.W., and W., they have become interwoven with the granite and whinstone drift from Scotland. In the neighbourhood of the Caldbeck Fells the most conspicuous erratic is what may be called tessellated porphyritic claystone. The porphyritic and granitic erratics are both a part of the boulder-clay deposits of the plain of Cumberland which extend from the mountains to the sea-coast. The lower boulder-clay preponderates, but upper boulder-clay may here and there be traced, especially towards the sea-coast. At Abbey Town, 50 feet above the sea-level, the upper boulder-clay contains numerous rounded and subangular stones, very much striated. As proved by well-sinkings, it is underlain by sand and gravel.

Interweaving of Drifts.—The above-mentioned, and other drifts, have not only been dispersed from centres in various directions in a manner quite inexplicable to me by glaciers or streams of land-

¹ Mr. Eccleston, of the Fawcett Schools, Carlisle, informs me that he has found boulders of Criffell granite as far east as Gillsland, and as far south as Whit beek, near Bootle. If I recollect rightly, there are numbers of them in the West-Midland counties.

² I have to thank the Messrs. Newall, of the Craig Nair (Dalbeattie) Granite Works, for corroborating my views, founded on Professor Sedgwick's theory, relative to the derivation of the Cumberland boulders.

ice (unless we feel justified in having recourse to a new order of causes and an entire change in physical conditions), but they have become mutually interwoven to an extent which, I believe, can only be accounted for by ice-laden currents, shifting their direction with the progress of subsidence, and drift-currents variously directed by changing winds.

The granite of the Criffell and Dalbeattie area, during its dispersion in directions between E. and S.S.E., has been crossed at various, including right-angles, by porphyritic and syenitic drift from the Caldbeck and Carrock Fells, over an area at least twelve miles in breadth.

Between S.E. and nearly S., Criffell granitic drift has been obliquely crossed, at various angles, by porphyry, trap, etc., from the Caldbeck hills, over the sea-coast area embraced by the granite, as far at least as Whitehaven.

Between S.E. and nearly S., Criffell granite, thinly dispersed over the southern part of the above sea-coast area, as far at least as St. Bees, has been extensively crossed, at right-angles and obliquely, by syenite and porphyry from Ennerdale and the neighbourhood.¹

Porphyry, trap, etc., from the Caldbeck hills, in its south-western dispersion, has been crossed at various angles by syenite and porphyry from the mountains above Crummock and Buttermere waters, and the interior neighbourhood, over an area at least six miles in breadth; and the same syenitic and porphyritic drift has crossed the granitic drift (already crossed by Caldbeck drift) over an area attaining a breadth, on the sea-coast, of at least eight miles, from beyond Maryport to the neighbourhood of Harrington.

Quadripartite Division of Drifts in Cumberland.—The abruptness with which my last article in the *GEOL. MAG.* (Oct., 1870) concluded, may render a few additional notes on this subject necessary.—The drifts of Cumberland are more or less interwoven in *vertical* as well as horizontal succession. The upper red loamy clay (partly derived from the waste of the Permian strata), as already hinted, contains few boulders, but they are not altogether absent. I saw a large boulder of granite identical with that now quarried near Dalbeattie, in this clay, between Maryport and Flimby; and, a short distance to the N.W. of Carlisle, near the R. Eden, I saw two boulders of Dalbeattie granite (one of them $5 \times 2 \times 3$ feet) in upper boulder-clay, in a railway cutting. Farther N.E., on the opposite bank of the river, a considerable thickness of the upper clay with boulders, may be seen resting on stratified gravel and sand—the latter resting on red sandstone rock. The sand and gravel formation of various parts of the plain of Cumberland (in the neighbourhood of Carlisle, Wetherall, Wigtown, Bullgill station,² Lamplugh, St. Bees, etc.) contains pebbles and a few boulders of most, if not all, of the rocks found in the clay above and below. The finest section of sand and gravel, nearly horizontally stratified, I have yet seen in Cumberland, is near Harrington, where it composes a denuded knoll, and attains

¹ I have lately found that limestone drift (including a split-block 10 feet in diameter and of unknown thickness) from the N. or W. has been left on the western slope of Dent Hill, near Cleator, by a current which, at a greater or less angle, must have been crossed by the above-mentioned syenitic and porphyritic drift from Ennerdale, which covers nearly the whole of Dent Hill (Skiddaw Slate) up to the summit, near to which, at 1,100 feet above the sea, there is a boulder, $8 \times 8 \times 5$ feet, called Samson's Cobble, or the Finger Stone, consisting of rock midway between porphyry and syenite.

² Here it forms a plateau, and rests partly on rock and partly on the reddish-brown clay.

a thickness of at least 50 feet. The reddish or yellowish-brown lower boulder-clay, which is often varied by a light bluish or greenish tint, contains the greatest number of large boulders. In many places, from Penrith to Workington, and elsewhere, it attains a great thickness. It has been mainly derived from the waste of the volcanic rocks and Coal-measure shales of Cumberland. The underlying bluish-grey clay rises to a height of at least 900 feet near Troutbeck railway station. It may be traced in the railway cutting not only between Troutbeck and Bassenthwaite lake, but between Cockermouth and Workington; between Marron Junction and Bridgefoot, where it is distinctly overlain by the reddish-brown clay; south of Branthwaite station, at Ullock station, where it is covered by a cargo of enormous boulders of sandstone, limestone, porphyry, etc.—the latter surmounted by red clay, sand, and gravel; and in other places. I have not seen any decided blue clay much farther north than the river Derwent. It would appear to have been chiefly derived from the waste of the Skiddaw Slates. There can be no doubt that in a great part of Cumberland, as well as in West Yorkshire (see my paper on *West Riding Drifts in the forthcoming Proceedings of the West Riding Geological Society*), there are four boulder drifts, two or three of which are often found in vertical succession, and the order of which is never found reversed. The extent to which these drifts have been removed by denudation, and the absence of sufficiently extensive sections, are probably the reasons why no very decided instance, so far as I am aware, has yet been discovered, in which all the four drifts are present.

In a few months I hope to be able to communicate an article, with a map, on the Drifts and Glaciated Rock-surfaces of the country between Whitehaven and Blackcombe, including the Eskdale granitic area.¹

NOTICES OF MEMOIRS.

I.—ON THE CORRELATION OF THE JURASSIC ROCKS IN THE DEPARTMENT OF THE CÔTE-D'OR, FRANCE, WITH THE OOLITIC FORMATIONS IN THE COUNTIES OF GLOUCESTER AND WILTS, ENGLAND.²
By THOMAS WRIGHT, M.D., F.R.S.E., F.G.S., etc.

THE department of the Côte-d'Or, which forms the northern portion of the Duchy of Burgundy, contains a very complete

¹ In Professor Harkness' paper on Shapfell Blocks in the Quart. Journ. Geol. Soc. for November, it is stated that Shapfell granite does not occur in the Boulder-clay of the Eden valley, though Criffell granite is found in this clay. The Eden valley clay may have nearly ceased to accumulate before the high-level granite of Wasdale Crag began to be dispersed, and imbedded in the *pinel* or Boulder-clay of the mountains, in which it is associated with polished and striated stones and boulders. (See article on *Shapfell Boulders*, GEOL. MAG., Aug., 1870.)

² Read at the Meeting of the Cotteswold Club, Aug. 31, 1869, and published in the Proceedings for 1869, pp. 143-237.